Chapter 7. Future Studies and Data Needs

Physical Processes Data Needs

Improved Gage Data

The flood and mean daily hydrology of the San Joaquin River is very poorly documented, especially in the reaches downstream of Mendota Dam. Although a large number of agencies maintain gages (DWR, USBR, USGS), there is no central data repository nor data recovery format. A more comprehensive understanding of the existing hydrology would be invaluable for designing successful riparian restoration projects. Other agencies responsible for floodplain management, levee and channel maintenance, and planning for flood risk reduction would also benefit from better hydrologic records and access to real time stage-discharge data in Reaches 3, 4, and 5.

Additional Stage Calibration Data

Reliability of hydraulic model results (e.g., estimation of stage-discharge relations and water surface profiles) for reaches 2–5 can be improved by installing a network of peak stage gages to record water-surface elevation at peak discharge events. Peak stage gages are relatively inexpensive to install, but they require staff time to monitor and reset them between flood events. Once installed, information from the stage gage network can be supplemented with data from periodic surveys of apparent high water marks along specific reaches and the combined results integrated with flow gage data and hydraulic model databases to improve the accuracy and reliability of simulated flow conditions at a full range of discharges.

Integrated, Continuous Hydraulic Model

Existing hydraulic models of subreaches within the study area have been established primarily to evaluate the flooding limits of 50- to 200-year events. These models are therefore not particularly useful for evaluating a lower range of river stage associated with more frequent flows. Furthermore, the models are spatially restricted.

There is a need, therefore, for an integrated continuous model that would effectively simulate and predict both in-channel and out-of-bank flows. The most appropriate one-dimensional hydraulic model is the Corps' UNET model. A UNET or similar hydraulic model of the study area is required before further quantitative geobotanical analyses can be conducted.

An integrated and continuous hydraulic model would permit quantitative analyses of sediment transport. In the upper reaches where the bed material is coarsest and the bed of the channel is armored, the hydraulic model would enable incipient motion analyses to determine the range of flows that would be required to mobilize the bed and bar material. Sufficient detail would be required in the hydraulic model to fully represent the flow splits and ineffective flow areas caused by the sand and gravel extraction, since these will have a major effect on bed material mobilization in various areas in Reach 1. Where the bed material is primarily sand (Reaches 2–5), sediment continuity analyses using appropriate transport algorithms can be used to determine reach-wide patterns of aggradation and degradation. The ability to perform these analyses will be especially important in evaluating the consequences of changes to the flow regime operation, such as modifying flood release timing, peak discharge, and stage to benefit riparian regeneration or to improve channel geometry and sediment transport.

A hydraulic model of the bypasses, including all the flow bifurcations and convergence of bypass flows with the mainstem of the San Joaquin River, could be used to simulate variations in the proportion of flow routed through the bypasses in relation to the proportion of flow kept in the mainstem river. A bypass model could also be used to evaluate the bank and channel stability of bypass levees and to provide the basis for design of any required stabilization measures or improvements in the hydraulic or sediment transport capacity of the flood bypass system.

The planned comprehensive watershed study of the San Joaquin River by the Corps may provide the required UNET model for the study area. The evaluations by the USFWS San Luis Refuge of nonstructural flood control measures in the floodplain of the river near Bear Creek may also produce important information regarding the potential for riparian restoration and the effects of overbank flooding on sediment transport and the ecology of the historic flood basin and sloughs. The topographic surveys that will be required to support the Corps and USFWS work will provide the density of topographic, bathymetric, and cross section data needed to better evaluate physical changes in the system since the CDC 1914 baseline survey and since construction of the flood bypass project.

Riparian Habitat Data Needs

Recent Recruitment and Regeneration

This study included a reconnaissance-level evaluation of natural regeneration throughout the 150-mile study area. A better understanding of the potential for and limitations to natural regeneration along the San Joaquin River would be gained from a more detailed map of the occurrence of concentrations of seedlings and saplings. Of particular interest is the fate of cottonwood and willow seedlings and saplings observed in the post-flood year of 1997. New crops of riparian vegetation that apparently established in the channel between the wet years of 1995 and 1997 may have been scoured by recent (1997–1998 water year) high flows during the past winter and spring. In subreaches with intermittent flow, a valuable indication of the potential for cyclical recruitment of new vegetation following unusually wet year sequences would be the extent and pattern of post-flood survival, particularly in reach 2 and on the floodplain surfaces of reaches 4B and 5. Repeat sampling transects could be established at sites with concentrations of seedlings and saplings of interest. More extensive locating of new stands, including the composition of dominant species and the height above the low-flow water surface, could easily be accomplished by a longitudinal survey with a GPS unit and data logger.

Relation of Vegetation Type to River Stage

Riparian vegetation and species concentrations generally occur within distinct vertical bands corresponding to a range of flow stage. Species tend to be sorted by their tolerance of inundation and scour at lower vertical gradients and tolerance of drier soil and greater depths to the water table at higher vertical gradients. Little is known about the distribution of riparian vegetation along a vertical gradient on the San Joaquin River. Once the Corps' topographic surveys and hydraulic model of the river have been completed, riparian vegetation could be sampled using GPS units and total station electronic survey equipment to record the occurrence of riparian species along river transects. Elevation above the thalweg or a known water surface could then be correlated with stage-discharge frequency data from the hydraulic model. Results could be used to quantify natural regeneration potential, select suitable sites for restoration projects, and develop appropriate mixes of species for planting projects at particular elevation zones along the river.

Corridor Map of Low Floodplains

This study discusses the low frequency of overbank flow along the river. However, lower floodplain surfaces will flood more often than higher surfaces, are more likely to be scoured or receive fresh deposition that favors the germination of the seeds of riparian species, and are closer to the water table for plant roots. Therefore, lower floodplains are generally better sites for riparian restoration. Planning and setting priorities for riparian restoration projects or land acquisition would benefit greatly from a map of higher-frequency floodplain areas along the active channel (i.e., sites at lower elevations in relation to river stage). This could be a component product of the Corps' topographic and hydraulic model of the San Joaquin River, but only if the model is developed with higher-frequency flow input and sufficient topographic detail for low surfaces closer to the channel rather than using more generalized cross sections typically used for models of 50–200 year events.

Low-lying agricultural fields adjacent to the river are more prone to damage from flood events and may be more available for both publicly-sponsored or private revegetation projects. A secondary advantage of returning low fields to riparian floodplain habitat is the possibility of removing local field berms and levees close to the channel, thereby increasing the hydraulic capacity of the floodway and reducing the maintenance burden on local levee districts. A map of the 5–15 year floodplain is an essential tool for identifying the reach-specific potential and the geographic extent of riparian floodplain restoration projects, whether for acquiring land and easements or to focus private lands incentives programs and technical assistance. The map should include subcategories of existing natural vegetation, idle agricultural land, and annual or perennial crops and indicate whether there is evidence on aerial photographs of recent deposition or scour. This information can be integrated into the GIS database of vegetation types developed for the study of historical riparian habitat conditions along the river. The identification of suitable restoration sites can be used to focus land acquisition or conservation easement programs or provide technical assistance for revegetation on private lands.

Age Classes of Mature Riparian Habitat

Little is known about the age class distribution of riparian vegetation along the San Joaquin River. A diversity of age classes throughout the riparian forests would indicate a healthy system. A representative assortment of stands of mature vegetation could be selected for tree core samples to determine the age class distribution and the elapsed time since the most recent population recruitment. This would be of particular interest in Reaches 4B and 5, where comparison of older aerial photographs to 1993 photos appears to indicate the same forest stands are present but in somewhat lower densities and absolute cover. Age class distribution could be correlated with the salinity of surface soil or depth to shallow saline groundwater in affected areas and with

categories of geomorphic surfaces or disturbance frequencies (e.g., on natural levees versus within the active channel or on basin rim soils).

Salinity Concentrations on Surface Soils

Salinity of surface soils associated with shallow saline groundwater is a suspected factor in the suppression of natural recruitment of riparian vegetation in portions of reaches 3, 4, and 5. Boron, which is also present in shallow groundwater in the same area, is also a potential limiting factor for the ability of cottonwood and willow seeds to germinate or survive as small seedlings. Secondary channels and moist depressions in reaches 4B and 5 are potentially suitable planting sites as well, but more should be known about the possible effects of boron and EC levels on riparian plants before projects are implemented in affected areas. Soil samples should be collected in areas where shallow groundwater is thought to be near the surface either perennially or seasonally. These samples can be sent to an agricultural soil-testing laboratory for about $30 per sample for a complete soil deficiency analysis, including salinity and boron levels and other characteristics important to plant survival and growth potential. The surface soils on the west bank of the San Joaquin River should also be sampled to verify whether saline shallow groundwater is suppressing the establishment of vegetation along the active channel in Reach 4B and 5.

River Corridor Profile of Shallow Groundwater

Figures 5.1 through 5.3 show generalized regional elevations of shallow groundwater in the Grasslands and Fresno regions of the San Joaquin Valley. These maps are less accurate for predicting the levels of shallow groundwater in relation to the river thalweg or along a relatively narrow corridor of the floodplain bordering the river and major sloughs. A subset of existing well log data could be evaluated by selecting only those wells in close proximity to the channel. Riparian well logs covering many years could be entered on a hydrologic database to develop apparent groundwater surface profiles for spring and fall (i.e., the beginning and end of the growing season) for different year types, such as wet, normal, and dry years. This information would be a valuable, quantifiable predictor of riparian regeneration potential and could be used to help select suitable sites for revegetation projects. Riparian groundwater profiles could also serve as a criteria for the purchase of lands or easements to reestablish riparian habitat in the floodplain and flood basins along the river or to predict the loss of low flows in the channel based on whether the water table is above or below the thalweg.